REGULATION 5.22 ***Procedures for Determining the Maximum Ambient Concentration of a Toxic Air Contaminant***

Louisville Metro Air Pollution Control District
Jefferson County, Kentucky

Pursuant To: KRS Chapter 77 Air Pollution Control
Relates To: Chapter 5 of the District's regulations.
Necessity and Function: KRS 77.180 authorizes the Air Pollution Control Board to adopt and enforce all orders, rules, and regulations necessary or proper to accomplish the purposes of KRS Chapter 77. This regulation establishes the procedures for determining the maximum concentration of a toxic air contaminant in the ambient air.

SECTION 1 Determining the Maximum Ambient Concentration of a Toxic Air Contaminant

1.1 The maximum ambient concentration of a TAC determined by one of the procedures in Sections 2 to 5 shall be used to determine compliance with the ambient goals for environmental acceptability (EA goals) established in Regulation 5.21.

1.2 For intermittent emissions, the average emission rate may be used to determine the maximum ambient concentration. Intermittent emissions are emissions that are not allowed to be emitted continuously for the entire length of the time specified in Regulation 5.20 as the applicable averaging time for a benchmark ambient concentration.

1.3 Each procedure in Sections 2 to 5 represents an acceptable method for determining the maximum ambient concentration of a TAC, although there are stated limitations for the use of the Tier 2 procedure. In general, the intent is that the Tier 1 procedure is the most simple to use, requires the least amount of process- and process equipment-specific information, and provides the most conservative maximum ambient concentration; proceeding on a continuum, the Tier 4 procedure is the most complex to use, requires the greatest amount of process- and process equipment-specific information, and provides the least conservative maximum ambient concentration. The following is a brief description of the four procedures:

1.3.1 Tier 1 - Table 1: Simple Factor for Determining Maximum Ambient Concentration: The allowed emission rate for the appropriate averaging time for the specific TAC is divided by a factor from the table to give the maximum ambient concentration.

1.3.2 Tier 2 - Table 2: Annual Factor: The allowed hourly emission rate is divided by the appropriate annual factor from the table to give the maximum ambient concentration. The annual factor from the table depends on the building height, stack height-to-building height ratio, and the distance to the closest property line, and the annual factor from the table may be adjusted depending on the averaging time of the BAC for the specific TAC.

1.3.3 Tier 3 - SCREEN3 and TSCREEN Models: The output of these screening models is the maximum hourly ambient concentration. The maximum hourly ambient concentration may be multiplied by an adjustment factor depending on the averaging time of the BAC for the specific TAC. The models contain different algorithms based upon the type of release, for example, stack or fugitive. Basic dispersion modeling parameters are required, such as building height and dimensions, stack height, stack diameter, exhaust gas flow rate, exhaust gas temperature, and emission

rate for a stack emission.

1.3.4 Tier 4 - EPA-Approved Dispersion Model: The output of these highly complex models is the maximum ambient concentration for the identified averaging time, which is set within the model depending on the averaging time of the BAC for the specific TAC. The models contain different algorithms based upon the type of release, for example, stack or fugitive. Detailed dispersion modeling parameters are required.

1.4 If there is not an established applicable emission limit for a TAC, then the potential to emit for that TAC shall be used. However, pursuant to Regulation 5.21, the owner or operator of the stationary source may request a new emission limit for that TAC that, upon receipt by the District, may be used to determine the maximum ambient concentration pursuant to Regulation 5.22.

1.5 If the District determines that the model chosen, model options, or model inputs are not appropriate to model the emissions from a process or process equipment, then the District may disapprove the results of the modeling demonstration.

SECTION 2 Tier 1 - Table 1: Simple Factor for Determining Maximum Ambient Concentration

2.1 The maximum concentration of a TAC from a process or process equipment in the ambient air may be determined by using the appropriate factor from Table 1 and the applicable Equation 1 to 4. The appropriate factor is determined by the averaging time for a specific TAC, which is established in Regulation 5.20. The calculated maximum concentration is then used in determining compliance with the EA goals in Regulation 5.21 by using the applicable equation in Regulation 5.21. If Table 1 contains two factors for a benchmark ambient concentration (BAC) averaging time, then the factor that results in the greater maximum concentration shall be used.

2.2 Table 1 *Simple Factor for Determining Maximum Concentration* reads as follows:

Table 1
Simple Factor for Determining Maximum Ambient Concentration

BAC[1] Averaging Time	Annual Factor (F_A)[2]	24-Hour Factor (F_{24})[3]	8-Hour Factor (F_8)[4]	1-Hour Factor (F_1)[5]
Annual	480			0.54
24 hours		0.12		0.05
8 hours			0.02	0.02
1 hour				0.001

Notes for Table 1:

[1] BAC is the benchmark ambient concentration of a TAC as determined pursuant to Regulation 5.20.

[2] The Annual Factor F_A is in units of (lb/year)/(μg/m^3). Use Equation 1.

[3] The 24-Hour Factor F_{24} is in units of (lb/24 hours)/(μg/m^3). Use Equation 2.

[4] The 8-Hour Factor F_8 is in units of (lb/8 hours)/(μg/m^3). Use Equation 3.

[5] The 1-Hour Factor F_1 is in units of (lb/1 hour)/(μg/m^3). Use Equation 4.

$$Maximum\ Concentration_{i\,j} = \frac{Allowed\ annual\ emission_{i\,j}}{F_A} \qquad Equation\ 1$$

$$Maximum\ Concentration_{i\,j} = \frac{Allowed\ 24\text{-}hour\ emission_{i\,j}}{F_{24}} \qquad Equation\ 2$$

$$Maximum\ Concentration_{i\,j} = \frac{Allowed\ 8\text{-}hour\ emission_{i\,j}}{F_8} \qquad Equation\ 3$$

$$Maximum\ Concentration_{i\,j} = \frac{Allowed\ 1\text{-}hour\ emission_{i\,j}}{F_1} \qquad Equation\ 4$$

Where: i = an individual TAC, from
j = an individual process or process equipment,
Allowed emission is in units of pounds per the applicable time period, and
Maximum Concentration is in units of μg/m^3.

SECTION 3 Tier 2 - Table 2: Annual Factor for Determining Maximum Ambient Concentration

3.1 The maximum concentration of a TAC from a process or process equipment in the ambient air may be determined by using the appropriate annual factor from Table 2 (adjusted if appropriate) and Equation 5. The calculated maximum concentration is then used in determining compliance with the EA goals in Regulation 5.21 by using the applicable equation in Regulation 5.21.

3.2 The use of Table 2 requires information about the dispersion characteristics of the source of emissions, namely, the distance to the nearest property line, the height of the stack, and, as described in section 3.7.2, the height of the influential building.

3.3 Table 2 shall not be used if any of the following provisions applies:

3.3.1 The stack height is less than 10 feet or the emission is a fugitive emission,

3.3.2 The influential building height is more than 100 feet,

3.3.3 There are terrain elevations that are more than 25% of the discharging stack height within a distance of 500 feet from the stack, or

3.3.4 The analysis is for an elevated receptor, for example, a hospital air intake.

3.4 The annual factor value derived from Table 2 is the ratio of the annual averaged hourly emission rate divided by the maximum annual ambient impact, in units of (lbs/hr)/($\mu g/m^3$).

3.5 The annual factor shall be adjusted if the averaging time of the BAC for the specific TAC as determined pursuant to Regulation 5.20 is different than annual. This adjustment is done as follows:

3.5.1 24-hr factor (lbs/hr)/($\mu g/m^3$) = annual factor θ 0.091.

3.5.2 8-hr factor (lbs/hr)/($\mu g/m^3$) = annual factor θ 0.046.

3.5.3 1-hr factor (lbs/hr)/($\mu g/m^3$) = annual factor θ 0.02.

3.6 Determine the maximum concentration. This is done by using the allowed hourly emission limit (lb/hr), taking into account the intermittent emission provision of section 1.2, for a TAC from a process or process equipment; the annual factor as derived from Table 2 and, if appropriate, making the adjustment pursuant to section 3.5; and performing the calculation in Equation 5. The resulting maximum concentration is in units of $\mu g/m^3$:

$$Maximum\ Concentration_{i\,j} = \frac{Allowed\ 1\text{-}hour\ emission_{i\,j}}{annual\ (adjusted)\ factor} \qquad Equation\ 5$$

Where: i = an individual TAC, from
j = an individual process or process equipment, and
annual (adjusted) factor is the annual factor derived from Table 2, including any adjustment required by section 3.5.

3.7 Instructions for deriving the annual factor from Table 2 are as follows:

3.7.1 Determine the height of the discharging stack from ground level in feet (H_s).

3.7.2 Determine the height of the influential building in feet (H_b). This is done by first identifying all buildings, including buildings on-site and off-site, located within a distance of 5 times their height from the discharging stack. Then, determine which building is the highest. This is the influential building, with height (H_b) in feet. If the stack is not attached to a building, then a building height of 40% of the stack height shall be assumed.

3.7.3 Determine the ratio of the stack height to the influential building height by dividing

the stack height, in feet, by the influential building height, in feet, H_s / H_b.

3.7.4 Determine the minimum distance, in feet, from the discharging stack to the property line. If there is no property line, then a distance of 25 feet shall be used.

3.7.5 Determine the appropriate annual factor from Table 2. This is done by selecting the column with the appropriate influential building height and H_s / H_b ratio, and selecting the row with the appropriate minimum distance to the property line.

3.7.5.1 If the influential building height is between values in the column headings, then use the column with the lower value or interpolate between values in the column headings.

3.7.5.2 If H_s is less than H_b, then set the influential building height equal to the stack height and use the 1.25 H_s / H_b column.

3.7.5.3 If H_s / H_b is between 1 and 1.25, then select the 1.25 column.

3.7.5.4 If H_s / H_b is between 1.25 and 1.75, then use the 1.25 column or interpolate between the 1.25 and 1.75 columns.

3.7.5.5 If H_s / H_b is between 1.75 and 2.5, then use the 1.75 column or interpolate between the 1.75 and 2.5 columns.

3.7.5.6 If H_s / H_b is greater than or equal to 2.5, then use the 2.5 column.

3.7.5.7 If the minimum distance to the property line is between 2 distances in the row headings, then use the row with the lower value or interpolate between values in the row headings.

3.8 Table 2 *Annual Factor* reads as follows:

Table 2 Annual Factor

	Bldg Ht	10			20			30			40		
	H_s / H_b	1.25	1.75	2.50	1.25	1.75	2.50	1.25	1.75	2.50	1.25	1.75	2.50
	Stck Ht	12.5	17.5	25	25	35	50	37.5	52.5	75	50	70	100
D	25	0.0085	0.022	0.159	0.032	0.084	0.679	0.075	0.220	1.603	0.152	0.421	2.941
I	50	0.0087	0.022	0.159	0.032	0.084	0.679	0.075	0.220	1.603	0.152	0.421	2.941
S	75	0.0096	0.022	0.159	0.032	0.084	0.679	0.075	0.220	1.603	0.152	0.421	2.941
T	100	0.011	0.023	0.159	0.033	0.084	0.679	0.075	0.220	1.603	0.152	0.421	2.941
A	200	0.020	0.040	0.159	0.042	0.084	0.679	0.082	0.220	1.603	0.157	0.421	2.941
N	300	0.030	0.053	0.178	0.059	0.116	0.679	0.099	0.221	1.603	0.174	0.421	2.941
C	400	0.040	0.065	0.171	0.077	0.140	0.679	0.126	0.268	1.603	0.200	0.421	2.941
E	500	0.051	0.077	0.189	0.094	0.164	0.679	0.153	0.318	1.603	0.243	0.505	2.941
	600	0.063	0.091	0.222	0.112	0.188	0.746	0.181	0.368	1.603	0.287	0.588	2.941
F	700	0.075	0.104	0.241	0.130	0.211	0.812	0.208	0.413	1.603	0.328	0.664	2.941
T	800	0.089	0.119	0.257	0.148	0.235	0.768	0.235	0.459	1.608	0.370	0.740	2.941
	900	0.103	0.134	0.264	0.167	0.258	0.770	0.261	0.502	1.672	0.411	0.812	2.941
	1000	0.119	0.151	0.272	0.187	0.282	0.800	0.289	0.545	1.786	0.452	0.883	2.959
	1500	0.209	0.245	0.318	0.290	0.406	1.080	0.428	0.756	1.953	0.654	1.214	3.521
	2000	0.311	0.350	0.383	0.408	0.539	1.256	0.573	0.965	2.304	0.861	1.534	3.731

Table 2 Annual Factor (Con=t)

	Bldg Ht	50			60			70			80		
	H_s / H_b	1.25	1.75	2.50	1.25	1.75	2.50	1.25	1.75	2.50	1.25	1.75	2.50
	Stck Ht	62.5	87.5	125	75	105	150	87.5	123	175	100	140	200
D	25	0.263	0.736	4.630	0.412	1.114	6.098	0.606	1.656	8.621	0.839	2.242	8.333
I	50	0.263	0.736	4.630	0.412	1.114	6.098	0.606	1.656	8.621	0.839	2.242	8.333
S	75	0.263	0.736	4.630	0.412	1.114	6.098	0.606	1.656	8.621	0.839	2.242	8.333
T	100	0.263	0.736	4.630	0.412	1.114	6.098	0.606	1.656	8.621	0.839	2.242	8.333
A	200	0.266	0.736	4.630	0.413	1.114	6.098	0.606	1.656	8.621	0.839	2.242	8.333
N	300	0.282	0.736	4.630	0.426	1.114	6.098	0.614	1.656	8.621	0.845	2.242	8.333
C	400	0.312	0.736	4.630	0.455	1.114	6.098	0.641	1.656	8.621	0.868	2.242	8.333
E	500	0.351	0.743	4.630	0.498	1.114	6.098	0.683	1.656	8.621	0.909	2.242	8.333
	600	0.409	0.838	4.630	0.545	1.114	6.098	0.741	1.656	8.621	0.967	2.242	8.333
F	700	0.468	0.951	4.717	0.625	1.269	6.250	0.808	1.672	8.621	1.040	2.242	8.333
T	800	0.528	1.064	4.803	0.705	1.429	6.410	0.901	1.825	8.621	1.111	2.242	8.333
	900	0.585	1.168	4.854	0.781	1.572	6.579	1.000	2.016	8.621	1.235	2.488	9.091
	1000	0.644	1.276	4.950	0.861	1.724	6.849	1.101	2.203	9.091	1.359	2.732	10.000
	1500	0.924	1.761	5.376	1.232	2.404	7.042	1.577	3.106	9.615	1.953	3.846	11.905
	2000	1.205	2.222	5.882	1.603	3.049	7.353	2.041	3.968	9.615	2.525	4.808	12.821

Table 2 Annual Factor (Con=t)

	Bldg Ht	90			100		
	H_s / H_b	1.25	1.75	2.50	1.25	1.75	2.50
	Stck Ht	113	158	225	125	175	250
D	25	1.126	3.049	13.514	1.458	3.876	14.286
I	50	1.126	3.049	13.514	1.458	3.876	14.286
S	75	1.126	3.049	13.514	1.458	3.876	14.286
T	100	1.126	3.049	13.514	1.458	3.876	14.286
A	200	1.126	3.049	13.514	1.458	3.876	14.286
N	300	1.129	3.049	13.514	1.458	3.876	14.286
C	400	1.147	3.049	13.514	1.475	3.876	14.286
E	500	1.185	3.049	13.514	1.506	3.876	14.286
	600	1.244	3.049	13.514	1.563	3.876	14.286
F	700	1.316	3.049	13.514	1.634	3.876	14.286
T	800	1.404	3.049	13.514	1.730	3.876	14.286
	900	1.502	3.086	13.514	1.832	3.876	14.286
	1000	1.634	3.289	13.514	1.931	3.876	14.286
	1500	2.358	4.505	15.152	2.778	5.208	16.129
	2000	3.049	5.618	16.129	3.597	6.494	18.519

Notes for Table 2:

Bldg Ht is the building height, in feet,
H_s / H_b is the ratio of the stack height to the building height,
Stack Ht is the stack (or release) height, in feet, and
The annual factor is in units of (lbs/hr)/(μg/m^3).

SECTION 4 Tier 3 - SCREEN3 and TSCREEN Models

4.1 The maximum concentration of a TAC from a process or process equipment in the ambient air may be determined by using the EPA SCREEN3 or TSCREEN models, using the appropriate algorithm for the type of emission release, for example, stack or fugitive. The maximum concentration derived from the use of one of these models, with the adjustment identified in section 4.2 as appropriate, is then used in determining

compliance with the EA goals in Regulation 5.21 by using the applicable equation in Regulation 5.21.

4.2 The resulting maximum concentration from the SCREEN3 or TSCREEN model is in units of $\mu g/m^3$ for a 1-hour averaging time. If the averaging time for a BAC for the specific TAC as determined pursuant to Regulation 5.20 is other than 1 hour, then the resulting maximum concentration shall be adjusted as follows:

4.2.1 For a BAC with an 8-hour averaging time, multiply by 0.44,

4.2.2 For a BAC with a 24-hour averaging time, multiply by 0.22, and

4.2.3 For a BAC with an annual averaging time, multiply by 0.02.

4.3 The SCREEN3 model shall be run in the Aregulatory default mode@ as described in the SCREEN3 User=s Guide (EPA-454/B-95-004).

4.4 If the TSCREEN model is used, the model inputs and options used shall be included with the modeling results submitted to the District pursuant to Regulation 5.21.

SECTION 5 Tier 4 - EPA-Approved Dispersion Model

5.1 Tier 4 models.

5.1.1 After the effective date of this regulation, a stationary source using Tier 4 to determine the maximum concentration of a TAC from a process or process equipment in the ambient air shall use the American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD), or another appropriate model included in Appendix A *Summaries of Preferred Air Quality Models* of 40 CFR Part 51 Appendix W *Guideline on Air Quality Models*. The EPA Industrial Source Complex Model (ISC3) may continue to be used on a case-by-case basis with prior approval by the District. Additionally, a model included on the EPA list of Alternative Models (Case-by-Case) (formerly Appendix B *Summaries of Alternative Air Quality Models* of 40 CFR Part 51 Appendix W) may be used, provided that the use of the alternative model meets one of the three conditions for approval specified in 40 CFR Part 51 Appendix W ' 3.2.2(b) and prior approval is given by the District.

5.1.2 As used in section 5.1, the Amaximum concentration@ shall be the value derived using one of the following methods, as deemed applicable in section 5.2:

5.1.2.1 The calculated arithmetic mean of the maximum ambient concentrations derived from each of five consecutive years of meteorological data. The location for this calculated ambient concentration shall be the location associated with the highest of the five individual maximum ambient concentrations derived by the model, or

5.1.2.2 The maximum concentration derived by the model when using a single, continuous 5-year set of meteorological data.

5.1.3 The maximum concentration derived from the use of one of the models in section 5.1.1 is then used in determining compliance with the EA goals in Regulation 5.21 by using the applicable equation in Regulation 5.21.

5.2 The applicability of the methods in section 5.1.2 is as follows:

5.2.1 If the maximum concentration is determined by a Group 1 stationary source for a Category 1 TAC, then the method in either Regulation 5.22 section 5.1.2.1 or section 5.1.2.2 may be used,

5.2.2 If the maximum concentration is determined by a Group 1 stationary source for a Category 2 TAC, then the method in Regulation 5.22 section 5.1.2.2 shall be used, unless the owner or operator of the stationary source notifies the District in writing by March 31, 2007, that the method in Regulation 5.22 section 5.1.2.1 will be used for

the Category 2 TACs.

5.2.3 If the maximum concentration is determined by a Group 2 stationary source for a Category 1 or Category 2 TAC, then the method in Regulation 5.22 section 5.1.2.2 shall be used,

5.2.4 If an administratively complete application for a construction permit was received by the District on or before March 31, 2007, then the method in either Regulation 5.22 section 5.1.2.1 or section 5.1.2.2 may be used, or

5.2.5 If an administratively complete application for a construction permit is received by the District after March 31, 2007, then the method in Regulation 5.22 section 5.1.2.2 shall be used.

5.3 In running one of the models allowed pursuant to section 5.1.1, the model shall be set to report the maximum concentration for the averaging time period consistent with the averaging time established for the TAC pursuant to Regulation 5.20, except, if using the method in section 5.1.2.2, the model is run with a combined 5-year meteorological data set and the averaging time period for the TAC pursuant to Regulation 5.20 is annual, then the model shall be set to report the maximum concentation for the Aperiod.@

5.4 The ISC3 model shall be run in the Aregulatory default mode@ as described in the *User=s Guide for the Industrial Source Complex (ISC3) Dispersion Models*, Volume 1 (EPA-454/B-95-003a).

5.5 The AERMOD model shall be run in the "regulatory default mode" as described in the User's Guide for the AMS/EPA REGULATORY MODEL – AERMOD, EPA-454/B-03-001. Non-regulatory modeling options require approval by the District. The data requirements for AERMOD are source specific and the AERMOD Implementation Guide should be consulted regarding the recommended use of AERMOD for a particular situation.

SECTION 6 Model and Guidance Availability

6.1 Referenced models, including SCREEN 3, TSCREEN, ISC3 and AERMOD and Associated User and Implementation Guides, may be downloaded for free at www.epa.gov.

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